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(71) Applicant: ADVANCED POLYMER SYSTEMS, INC. [US/US]; 3696C Haven Avenue, Redwood City, CA 94063 (US).

(72) Inventors: NACHT, Sergio ; 289 Quinnhill Avenue, Los Altos, CA 94022 (US). SAXENA, Subhash, J. ; 2610 Monte Cresta Drive, Belmont, CA 94002 (US).

(74) Agents: HILLMAN, Albert, J. et al.; Townsend and Townsend Khourie and Crew, Steuart Street Tower, 20th Floor, One Market Plaza, San Francisco, CA 94105 (US).

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(54) Title: ANTIMICROBIAL DRY PAPER PRODUCT

(57) Abstract

Antimicrobial dry paper product utilizing a dry paper support such as paper towel with porous polymeric microbeads containing an entrapped antimicrobial liquid formulation dispersed on the paper support. The product may be used to dry surfaces such as wet hands while reducing bacterial count which may be present on the hands.

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ANTIMICROBIAL DRY PAPER PRODUCT

BACKGROUND OF THE INVENTION AND SUMMARY OF THE PRIOR ART

This invention relates to an antimicrobial product. More particularly, it relates to a dry paper wipe containing an antimicrobial solution carried by polymeric beads.

Antimicrobial compositions are well known in the art. Antimicrobial agents of the type utilized in the preferred embodiment of the present invention are disclosed in Richards, et al., Chem. Abst., Vol. 80 (1974), p. 66969f, (Orig. Article 1973). In this Abstract the authors report enhanced activity against Pseudomonas aeruginosa by combining the antimicrobial agent chlorhexidine acetate with a phenyl alkanol such as benzyl alcohol. The use of phenyl alkanols as potentiators for microbial agents is also disclosed in U.S. Patent No. 4,474,748.

A wet wipe comprising a porous sheet which serves as a support for polymeric beads containing a functional ingredient is disclosed in U.S. Patent No. 4,904,524. This patent mentions antimicrobials as one of the possibilities for the active ingredient to be included in the wet wipe. As will be seen, this patent differs from the present invention in connection with the fact that the porous sheet used for the wet wipe is impregnated with an aqueous lotion.

SUMMARY OF THE INVENTION

The present invention provides a dry paper product such as a paper towel that contains a liquid antimicrobial formulation. The paper is maintained in its dry state, notwithstanding the presence of the liquid antimicrobial formulation, by entrapping the liquid in polymeric microbeads. The microbeads are highly porous so that the necessary amount of liquid can be accommodated. At the same time the

microbeads themselves are present as a free-flowing powder that can be dispersed on the paper support.

Liquid is not discharged until the dry paper is used to dry a selected surface. For example, if a person washes his or her hands with plain water, the dry paper wipe of this invention can be utilized to rub against the hands to absorb the water and dry the hands. During this process the microbeads dispersed on the paper are contacted on the paper and many of the beads are transferred to the hands. The liquid antimicrobial solution from beads contacted in both locations is discharged onto the hands. The wiping and rubbing process, when completed, leaves the hands dry but also treated with the antimicrobial solution to significantly reduce any bacterial count which may have been initially present before contact with the dry paper wipe of this invention.

The dry paper wipe has a significant advantage over a wet wipe in that the porous microbeads hold the liquid antimicrobial formulation within pores of the beads until the dry wipe is utilized. In wet wipes the wetness in the wipe tends to cause a discharge of the antimicrobial solution from the beads prior to the time the wipe is sued. As a result, the dry wipe is a more effective antimicrobial product.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention utilizes any suitable dry paper support. In general, the support may be porous and of the type used as a dispensable paper product from a storage reservoir or container. Typical examples of the paper support would be toilet paper and conventional paper towels found in sheet dispensers and in rolls.

The carrier for entrapping the antimicrobial formulation is porous polymeric beads as disclosed in U.S. Patent No. 4,690,825. In the preferred embodiment the porous microbeads are formed from copolymerization of methyl methacrylate and ethylene dimethacrylate. A typical procedure for preparing the porous bead particles is disclosed in U.S. Patent No. 4,806,360.

More particularly, the preferred process from that patent is: A two-liter four-necked reaction flask equipped with a stirrer driven by a variable speed motor, reflux condenser, thermometer, and nitrogen-inlet tube was set up. A slow flow of nitrogen was maintained through the reaction flask at all times and initially was used to purge the flask. An aqueous phase made up of 450 parts of deionized water, 4 parts of gum arabic, and 4 parts of sodium lignosulfate was added to the flask, and an organic solution made up of 52 parts of methylmethacrylate, 78 parts ethyleneglycol dimethacrylate, 1.5 parts of benzoyl peroxide (70% in water), and 150 parts of toluene was dispersed in the aqueous phase with rapid stirring (stirrer speed approximately 900 rpm) to obtain a plurality of droplets having an average droplet size of below about 60 microns, as determined by visual observation of a sample of the droplets being stabilized by the dispersants.

The reaction mixture was heated to 65°C for one hour, then 75°C and allowed to remain at this temperature for approximately seven hours while maintaining a nitrogen flow of 2ml/minute to form porous beads of crosslinked methacrylate/ethyleneglycol dimethacrylate copolymer having toluene entrapped within the pores. The reaction mixture was then cooled and the beads collected by filtration, washed three times with 1000 parts of deionized water, and three times with 1000 parts of acetone, then dried in a vacuum oven at 80°C for about 24 hours.

The calculation of theoretical crosslink density of the purified beads was 60% calculated by dividing the weight of ethyleneglycol dimethacrylate (78g) by the weight of monomer (130g).

The surface area of a sample was 180.6m^2/g as measured by B.E.T. nitrogen multipoint analysis and the pore volume was .684ml/g as measured by Mercury porosimetry.

Microbeads having empty pores are obtained from the above process because the final heating step removes the entrapped toluene. The desired antimicrobial formulation is

loaded into the empty pores of the microbeads by mixing them together at ambient conditions.

A preferred formulation is an aqueous solution of the antimicrobial agent. Examples of suitable antimicrobial agents are chlorhexidine and its esters such as the digluconate and the acetate. Another example is triclosan, also know as Irgasan DP300. In the preferred embodiment a phenyl alkanol will also be included in the paper product which itself will be entrapped in porous polymeric microbeads. As will be seen in the preferred embodiment, an antiviral agent entrapped in porous polymeric microbeads will also be included so that the dry wipe can be used effectively against bacterial and viral species.

The following examples will illustrate the invention, with Example 1 serving as a comparative example.

Example 1 - Comparative Example

An antimicrobial solution was prepared in accordance with the following formula:

Table I

Nonoxynol 9	10.0%
Benzyl alcohol	2.0%
Chlorhexidine digluconate	8.0%
D.I. water q.s. to	100.0%

This antimicrobial solution was placed into a spray bottle. The solution was then sprayed onto toilet paper; the toilet paper broke apart and was not useful as a wipe.

The foregoing Example 1 illustrates that the desired dry paper support contemplated by the present invention which typically has relatively low wet strength cannot be used directly with the liquid or aqueous antimicrobial formulation. The following examples will demonstrate the effectiveness of utilizing polymeric microbeads to entrap the liquid solutions while maintaining the dryness of the paper support. The end product has sufficient strength to operate as a dry wipe.

In the following examples the microbeads utilized are prepared in accordance with the above-referenced example in U.S. Patent No. 4,806,360.

Example 2

An antimicrobial powder was prepared with the following (All percentages are by weight.):

Table II

40% nonoxynol 9 microbeads	22.9%
50% benzyl alcohol microbeads	3.7%
10% chlorhexidine and 40% water in microbeads	73.4%

The composition of the antimicrobial powder is shown in Table III.

Table III - Antimicrobial Powder Composition

Nonoxynol 9	9.2%
Benzyl alcohol	1.8%
Chlorhexidine digluconate	7.3%
D.I. water	29.4%
Microbeads	52.3%

This antimicrobial powder was placed into a shaker bottle and the powder was then shaken onto a double layer of toilet paper evenly. About 0.1g of powder was sprayed on a 16 inch x 4 inch strip of toilet paper. The hand was washed with tap water only and then dried with the powdered toilet paper. The white antimicrobial powder mixture was transferred to the palm of the hand after wiping. Further test indicated that a significant reduction in the number of bacteria on the hand was achieved.

The above examples illustrate one useful formulation. However, it will be appreciated that the active ingredients in the antimicrobial formulation can be varied. For example, the following table illustrates how the concentration of the various ingredients can be varied while still achieving the desired results of the dry wipe.

Table IV

40% nonoxynol 9 porous polymeric microbeads	18-28%
50% benzyl alcohol porous polymeric microbeads	2-5%
10% chlorhexidine digluconate and 40% water in porous polymeric microbeads	67-80%

WHAT IS CLAIMED IS:

1. An antimicrobial dry paper product comprising: a dry paper support having relatively low wet strength; a liquid antimicrobial formulation entrapped in porous polymeric microbeads, said microbeads with said entrapped antimicrobial formulation being free-flowing powder; said microbeads being dispersed on said paper support whereby when a surface is contacted with said paper support to dry the surface an effective amount of liquid antimicrobial formulation is discharged onto the surface to reduce the bacterial count which may be present.

2. A product in accordance with claim 1 wherein said liquid antimicrobial formulation comprises an aqueous solution of an antimicrobial agent.

3. A product in accordance with claim 2 wherein said antimicrobial agent is chlorhexidine or an ester thereof.

4. A product in accordance with claim 2 wherein said liquid antimicrobial formulation further includes a liquid potentiator for said antimicrobial agent entrapped in porous polymeric microbeads.

5. A product in accordance with claim 4 wherein said liquid potentiator is a phenyl alkanol.

6. A product in accordance with claim 5 wherein said phenyl alkanol is benzyl alcohol.

7. A product in accordance with claim 1 wherein said liquid antimicrobial formulation includes a liquid antiviral agent entrapped in porous polymeric microbeads.

8. A product in accordance with claim 7 wherein said antiviral agent is nonoxynol 9.

9. A product in accordance with claim 1 wherein said liquid microbial formulation contains the following in approximate percent by weight:

40% nonoxynol 9 porous polymeric microbeads	18-28
50% benzyl alcohol porous polymeric microbeads	2-5
10% chlorhexidine digluconate and 40% water in porous polymeric microbeads	67-80

10. An antimicrobial dry paper wipe comprising: porous dry paper; an aqueous antimicrobial solution entrapped in porous polymeric beads, said beads being dispersed over and supported on said dry paper; said porous beads containing sufficient dischargeable antimicrobial solution to substantially reduce the bacterial count when said paper wipe is rubbed against a selected surface.

11. A dry paper wipe in accordance with claim 10 wherein said antimicrobial solution comprises chlorhexidine or an ester thereof in water.

12. A dry paper wipe in accordance with claim 11 and also including porous polymeric beads having a phenyl alkanol potentiator entrapped therein.

13. A dry paper wipe in accordance with claim 12 wherein said phenyl alkanol potentiator is benzyl alcohol.

14. A dry paper wipe in accordance with claim 13 and also including an antiviral agent entrapped in porous polymeric beads.

15. A dry paper wipe in accordance with claim 14 wherein said antiviral agent is nonoxynol 9.

16. A dry paper wipe in accordance with claim 15 wherein said antimicrobial solution contains chlorhexidine digluconate.

17. A method for simultaneously drying and reducing the bacterial count on a surface comprising:

contacting a wet surface with the product of claim 1 and rubbing them together until wetness on said surface is absorbed by the paper product.

18. A method in accordance with claim 17 wherein the wet surface contacted is human skin.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/05785

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A01N 25/34
US CL :424/402, 404

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/402, 404

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P Y,P	US, A, 5,156,843 (LEONG ET AL) 20 OCTOBER 1992 See particularly the Example at column 8.	1,7,8 1-18
Y	US, A, 4,197,318 (SIPOS) 08 APRIL 1980 See particularly column 7, lines 57, 64, column 2, lines 57-64, column 5, lines 44, 45, 64-66 and column 6, lines 49-51.	1-18
Y	Chem. Abst. Vol. 80, 66969f, (1974) (RICHARDS ET AL.), "Enhancement of Benzalkonium Chloride and Chlorhexidine Acetate Activity Against Pseudomonas Aeruginosa by Aromatic Alcohols".	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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